Single Dose Preemptive Thoracic Paravertebral Block For Postoperative Pain Relief After Cholecystectomy

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ABSTRACT

The controversy over pre-emptive analgesia continues unabated, with studies both supporting and refuting its efficacy. Forty patients undergoing elective open cholecystectomy were randomized into two equal groups (20 patients each) to either pre-emptive thoracic bolus paravertebral block (PVB) with ropivacaine 0.5% (20 ml), before surgical incision (group I) or to receive the same block after termination of surgery (group II). The objective of this work is to evaluate thoracic PVB for pain control after open cholecystectomy and to compare its effects when given either before surgical incision or after termination of surgery. No differences in the postoperative pain scores were depicted, although the pre-emptive thoracic PVB offered a good opioid sparing effects. Patients in group I were more haemodynamically stable, intraoperatively. Pulmonary function, estimated by peak expiratory flow rate, decreased about 50% postoperatively in both groups. Minimal side effects occurred. In conclusion, a single bolus pre-emptive thoracic PVB with 20 ml ropivacaine 0.5% provides an opioid sparing effect postoperatively, and attenuates the stress response to surgery during isoflurane anaesthesia, a technique which deserves a more widespread use.

INTRODUCTION

Open cholecystectomy is notorious for causing severe postoperative pain and respiratory splinting that invites postoperative pulmonary complications. A myriad of analgesic regimens are currently in common use, but none appears to be completely satisfactory[1,2].

Postoperative pain following cholecystectomy may be controlled with systemic opiates, epidural analgesia, with or without narcotics, non-steroidal anti-inflammatory drugs, or posterior intercostal nerve block. Each method may have its advantages, the epidural regimen usually being very effective, but demanding experienced staff and a high degree of surveillance, because of the potential risk of hypotension, motor blockade and respiratory depression[3].

Pre-emptive thoracic paravertebral block (PVB) may have some advantages compared with the above – mentioned methods[3]. The concept of pre-emptive analgesia is based on the intuitive idea that if pain is treated before the injury occurs, the nociceptive system will perceive less pain than if analgesia is given after the injury has already occurred. Pre-emptive analgesia would apply well to the situation of elective surgery since in this situation it is possible to control the series of events and, thus, it is possible to deliver effective analgesia before the start of surgery[4].

Three possible advantages could be proposed in this regard. First, in order to achieve a pre-emptive effect it is likely that the intervention must be effective not only during and immediately after the surgical procedure, but also have a prolonged effect during the postoperative phase. The duration of the effect of single injection PVB has, in a number of studies, been shown to be >12h, regardless if the local anaesthetic was used alone or with adjunct drugs[5]. Second, PVB is capable of completely abolishing somato-sensory evoked potentials (SSEP) in a number of adjacent dermatomal segments. Thus, PVB can produce a very dense afferent blockade of sensory information[5]. Lastly, PVB does, in one specific way, differ from neuroaxial blocks. Although neuroaxial blocks cause almost complete blockade of the mainly efferent sympathetic transmission from the spinal cord, such blocks are not able to block transmission within the sympathetic chain. PVB, on the other hand, will cause not only dense somatic afferent blockade,
but will also, due to the anatomy of the paravertebral space, completely block transmission within the sympathetic chain. The role of pain transmission within the sympathetic chain for pain perception and sensitization process is still largely unknown but this unique quality of PVB may constitute to its efficacy(5).

AIM OF THE STUDY
Evaluation of thoracic PVB for pain control after cholecystectomy and comparison of its effects when given either before surgical incision or after termination of surgery.

PATIENTS
After approval by the local ethical committee, 40 adult patients, ASA status I or II, scheduled for elective open cholecystectomy, were included in this study. Patients with pulmonary diseases, obesity, deformities of the thoracic spine, and coagulopathies were excluded from the study. They were randomly allocated into two groups (20 patients each). In group I, patients received a PVB with ropivacaine in the right lower thoracic region, after induction of anaesthesia and before the surgical incision (i.e. pre-emptively). In group II, patients received a similar PVB with identical dose, after termination of surgery and before recovery from anesthesia. Patients with failed block were excluded from the study.

METHODS
A written informed consent was taken from all patients. After proper history taking, thorough clinical examination and all needed investigations, they were premedicated with oral midazolam 7.5 mg one hour before operation. All patients received general anaesthesia (GA) with a sleeping dose of thiopental 5mg.kg⁻¹, fentanyl 2μg.kg⁻¹ and atracurium 0.5mg.kg⁻¹ followed by tracheal intubation and IPPV. Anaesthesia was maintained with isoflurane 2% with 60% N₂O in oxygen, with incremental doses of atracurium as needed.

In group I: after induction of GA and before surgical incision, with the patient on lateral position, PVB was performed using a 18G Tuohy needle. The needle was inserted 2.5cm lateral and to the right of the spinous process of T8, perpendicular to the skin. It was gently advanced till it came in contact with the transverse process. Then the needle was re-angled superiorly and a syringe of air was attached, advanced gently for 1-2cm till loss of resistance was felt. At this point, 20ml of 0.5% ropivacaine was injected, the needle withdrawn and the patient was repositioned in the supine position and surgery was allowed to commence(6).

In group II: the same PVB was carried out but after termination of surgery and before recovery from GA.

Postoperatively, pethidine was given intravenously (20mg alliquots) when needed (if visual analogue score (VAS) is ≥3).

Measurements
On the day before surgery; 3,6,12, and 24 hours postoperatively, the peak expiratory flow rate (PEFR) in L.min⁻¹ was measured using a mini Wright's respirometer. Heart rate (beat.min⁻¹) and mean arterial blood pressure (MAB) (mmHg) were recorded before induction of GA, immediately after induction, 5 minutes after intubation then every 15 minutes till the end of surgery.

Postoperatively MAP and HR were recorded 4 hourly in the first 24 hours. Peripheral oxygen saturation (SPO₂) was measured, and any episode of desaturation, defined as SPO₂ below 95% on 40% O₂, or below 90% on air, which occurred intraoperatively or during the first postoperative 24 hours was recorded. Postoperatively, after the patient is awake enough to respond, a 10- point VAS (0 = no pain, 10= worst pain) was recorded every 3 hours. First time to ask for analgesia, total dose of pethidine (mg), and complications if any were reported in the first 24 hours postoperatively.

Statistics
All data were analyzed using the students t-test and chi square tests. p<0.05 was considered significant.

RESULTS
No significant difference was depicted between the two groups as regards demographic data (age, sex, body weight,
ASA classification and duration of surgery (table I).

Intraoperatively, the heart rate and mean arterial blood pressure were significantly lower in group I compared to group II (figure 1,2). Postoperatively, no significant differences were elicited between the two studied groups.

As regards SPO₂, no episodes of desaturation were encountered in both groups.

The PEFR was significantly impaired postoperatively, with no significant difference between the two groups (Figure 3).

No significant differences were elicited between the two groups as regards the postoperative pain score (VAS) (figure 4).

Table I: Demographic data in both groups.

<table>
<thead>
<tr>
<th></th>
<th>Group I</th>
<th>Group II</th>
<th>P</th>
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<tbody>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>33-58</td>
<td>26-60</td>
<td>0.3632</td>
</tr>
<tr>
<td>Mean</td>
<td>45.60</td>
<td>42.9</td>
<td></td>
</tr>
<tr>
<td>S.D</td>
<td>7.88</td>
<td>10.49</td>
<td></td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td>-</td>
</tr>
<tr>
<td>Male</td>
<td>3(15%)</td>
<td>3(15%)</td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>17(85%)</td>
<td>17(85%)</td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>55-95</td>
<td>60-90</td>
<td>0.5142</td>
</tr>
<tr>
<td>Mean</td>
<td>76.20</td>
<td>74.00</td>
<td></td>
</tr>
<tr>
<td>S.D</td>
<td>11.40</td>
<td>9.66</td>
<td></td>
</tr>
<tr>
<td>ASA</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>14 (70%)</td>
<td>15 (75%)</td>
<td>0.7233</td>
</tr>
<tr>
<td>II</td>
<td>6 (30%)</td>
<td>5 (25%)</td>
<td></td>
</tr>
<tr>
<td>Duration of surgery (minutes)</td>
<td>73.4 ± 3.5</td>
<td>72.8 ± 3.3</td>
<td>0.5802</td>
</tr>
</tbody>
</table>

Fig 1. Intraoperative heart rate changes in both groups.
Fig 2. Intraoperative mean arterial blood pressure changes in both groups.

Fig 3. Changes of the peak expiratory flow rate (PEFR) in both groups.
Fig 4. Postoperative visual analogue scale (VAS) in both groups.

Table II: Postoperative complications and need for analgesia in studied cases.

<table>
<thead>
<tr>
<th></th>
<th>Group I</th>
<th>Group II</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>First time to ask for analgesics (minutes)</td>
<td>126 ± 14.7</td>
<td>190 ±12.5</td>
<td>P&lt;0.0001</td>
</tr>
<tr>
<td>Total dose of pethidine (mg)</td>
<td>180 ±5.02</td>
<td>250 ±9.8</td>
<td>P&lt;0.0001</td>
</tr>
<tr>
<td>Nausea &amp; vomiting</td>
<td>2 cases 10%</td>
<td>2 cases 10%</td>
<td>-</td>
</tr>
</tbody>
</table>

Patients in group I asked first for analgesics after 126 ± 14.7 (minutes), while those in group II after 190 ±12.5 minutes, with a significant decrease in group I (P<0.0001) (table II).

The total dose of pethidine used to relieve pain in the first 24 hours was significantly lower in group I compared to group II (P<0.0001) (table II).

No severe side effects were observed. Failure of the block in 3 cases occurred, and they were excluded from the study. Nausea and vomiting occurred in 4 cases (2 cases in each group) (table II)

**DISCUSSION**

Since its introduction into the pain and anaesthesia literatures, the concept of preemptive analgesia has evolved, based in part on confirmatory and contradictory evidence from clinical studies, new developments in basic science. This evolution has led to progress in our understanding of the mechanism that contribute to acute postoperative pain. The suggestion that surgical incision triggers central sensitization has been expanded to include the sensitizing effects of preoperative noxious inputs and pain, other noxious intraoperative stimuli, postoperative inflammatory mediators and ectopic neural activity(7).

Although the results of the present study demonstrated no significant difference in postoperative VAS between the two studied groups, a significant opioid sparing effect of pre-emptive PVB was found.

In agreement, Giannoni et al(8) found that pre-emptive peritonsillar infiltration of ropivacaine with or without clonidine, reduced analgesic requirements up to 5 days after tonsillectomy(8). Also, Reuben et al(9), in a fascinating study, demonstrated the analgesic benefit, both in short and long-term, of local administration of morphine to the iliac bone graft harvest site during cervical spinal fusion surgery. They
achieved preventive analgesia by analgesic intervention which was started after surgery. Similarly, Kilickan and Tokor and Salonen et al disproved the preemptive effect of morphine and ketoprofen respectively, on postoperative pain scores, but they found a reduction in postoperative cumulative analgesic intake.

On the other hand, Reuben et al, in another study, demonstrated a reduction in postoperative pain scores, after pre-emptive intra-articular infection of bupivacaine and morphine for postoperative analgesia after ambulatory arthroscopic knee surgery. Also, Esmaoglu et al showed that pre-emptive epidural fentanyl administration has reduced postoperative pain scores after elective abdominal surgery.

In the present study, in group I, the significant reduction in the first time to ask for analgesia in the postoperative period can be attributed to the earlier onset of action of PVB (i.e. before the surgical incision). The present study demonstrated that a single pre-incisional thoracic paravertebral injection of ropivacaine 0.5%, 20 ml before open cholecystectomy, attenuated the stress response to surgical stimuli, during isoflurane anaesthesia. This was manifested by lower intraoperative values of heart rate and mean arterial blood pressure in patients of group I.

In agreement, Giesecke et al reported that a single preincisional thoracic paravertebral injection of bupivacaine 0.5%, 20 ml before cholecystectomy, attenuates the stress response to surgical stimuli during isoflurane anaesthesia. This was manifested by lower intraoperative values of heart rate and mean arterial blood pressure in patients of group I.

In conclusion, the present study has shown that a single dose pre-emptive thoracic PVB with ropivacaine 0.5%, 20 ml provides an opioid sparing effect in the postoperative period after cholecystectomy. Moreover, it attenuates the stress response to surgery during isoflurane anaesthesia with minimal or no side effect. In deserves a more widespread use.

REFERENCES